Patent claims

1. A circuit arrangement for compensating for disturbances in a signal generated by means of discrete multitone modulation (DMT), the signal generated by means of discrete multitone modulation exhibiting in the frequency domain a multiplicity of carrier frequencies which are used for transmitting data via a transmission channel, and each carrier frequency exhibiting a signal vector (a_1', b_1'; a_n, b_n'), comprising

- a multiplicity of first adder circuits (18, 19; 18-1, 19-1), the multiplicity of first adder circuits (18, 19; 18-1, 19-1) being supplied with a first error signal vector and the multiplicity of first adder circuits (18, 19; 18-1, 19-1) adding the first error signal vector to at least one first signal vector (a_n', b_n'; a_1', b_1') in order to generate an error-corrected first signal vector (a_n^*, b_n^*; a_n^*-1, b_n^*-1; a_1^*, b_1^*); and
- a multiplicity of first multiplier circuits (14, 15, 16, 17; 14-1, 15-1, 16-1, 17-1) which precede the multiplicity of first adder circuits (18, 19; 18-1, 19-1) and multiply the first error signal vector by adjustable coefficients ($C_{aa}^{(n)}$, $C_{ba}^{(n)}$, $C_{bb}^{(n)}$, $C_{ab}^{(n)}$; $C_{aa}^{(1,n)}$, $C_{ba}^{(1,n)}$, $C_{bb}^{(1,n)}$, $C_{ab}^{(1,n)}$; $C_{aa}^{(1)}$, $C_{ba}^{(1)}$, $C_{bb}^{(1)}$, $C_{ab}^{(1)}$; $C_{aa}^{(n,1)}$, $C_{ba}^{(n,1)}$, $C_{bb}^{(n,1)}$, $C_{ab}^{(n,1)}$), wherein the first error signal vector is a signal vector (a_r, b_r; a_{1r}, b_{1r}; a_r-1, b_r-1) of a carrier frequency which is not used for transmitting data via the transmission channel.

2. The circuit arrangement as claimed in claim 1, wherein the first error signal vector is a signal vector (a_r, b_r) of a carrier frequency which, in the frequency domain, is adjacent to a carrier frequency which is used for transmitting data via the transmission channel.

3. The circuit arrangement as claimed in claim 1 or 2, wherein the first error signal vector is a signal vector (a_r, b_r) of a carrier frequency which, in the frequency domain, immediately precedes a carrier frequency which is used for transmitting data via the transmission channel.

4. The circuit arrangement as claimed in claim 1 or 2, wherein the circuit arrangement also exhibits the following features:

- at least one further multiplicity of first adder circuits (18-2, 19-2 to 18-m, 19-m) which follow the multiplicity of first adder circuits (18, 19; 18-1, 19-1), the at least one further multiplicity of first adder circuits (18-2, 19-2 to 18-m, 19-m) in each case being supplied with a further error signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}; a_r-2, b_r-2, a_r-3, b_r-3) and the at least one further multiplicity of first adder circuits (18-2, 19-2 to 18-m, 19-m) adding the respective further error signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}; a_r-2, b_r-2, a_r-3, b_r-3) to the at least one signal vector (a_n', b_n') in order to generate a progressively error-corrected signal vector (a_n^*-2, b_n^*-2 to a_n^*-m, b_n^*-m); and
- at least one further multiplicity of first multiplier circuits (14-2, 15-2, 16-2, 17-2 to 14-m, 15-m, 16-m, 17-m) which precede the at least one further multiplicity of first adder circuits (18-2, 19-2 to 18-m, 19-m) and multiply the respective further error signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}; a_r-2, b_r-2, a_r-3, b_r-3) by adjustable coefficients ($C_{aa}^{(2,n)}$, $C_{ba}^{(2,n)}$, $C_{bb}^{(2,n)}$, $C_{ab}^{(2,n)}$ to $C_{aa}^{(m,n)}$, $C_{ba}^{(m,n)}$, $C_{bb}^{(m,n)}$, $C_{ab}^{(m,n)}$; $C_{aa}^{(n,2)}$, $C_{ba}^{(n,2)}$, $C_{bb}^{(n,2)}$, $C_{ab}^{(n,2)}$).

5. The circuit arrangement as claimed in claim 4, wherein the respective further error signal vector is in each case a signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}) of a

carrier frequency which is not used for transmitting data via the transmission channel.

6. The circuit arrangement as claimed in claim 4 or 5, wherein the respective further error signal vector (a_r-2, b_r-2, a_r-3, b_r-3) is in each case a previous version of a particular error signal vector (a_r-1, b_r-1).

7. The circuit arrangement as claimed in claim 6, wherein the circuit arrangement has at least one buffer circuit (20-1, 20-2) for storing a previous version of an error signal vector (a_r-1, b_r-1).

8. The circuit arrangement as claimed in claim 1, 2 or 3, wherein the circuit arrangement also exhibits the following features:

- a decision circuit (4-1) which maps the error-corrected first signal vector (a_1^*, b_1^*) into a value-discrete first signal vector (a_1", b_1"); and
- a subtracting circuit (6-1, 7-1) for forming a second error signal vector (Δa_1, Δb_1) which subtracts the first signal vector (a_1', b_1') and the value-discrete first signal vector (a_1", b_1") from one another,

the second error signal vector (Δa_1, Δb_1) being used for generating an error-corrected second signal vector (a_2^*, b_2^*) of a second signal vector (a_2', b_2') of a carrier frequency which is immediately adjacent to the carrier frequency of the first signal vector (a_1', b_1').

9. The circuit arrangement as claimed in claim 8, wherein the circuit arrangement also exhibits the following features:

- a multiplicity of second adder circuits (12-1, 13-1), the multiplicity of second adder circuits (12-1, 13-1) being supplied with the second error signal vector (Δa_1, Δb_1) and the multiplicity of second adder circuits

(12-1, 13-1) adding the second error signal vector (Δa_1, Δb_1) to the second signal vector (a_2', b_2') in order to generate the error-corrected second signal vector (a_2^*, b_2^*); and

- a multiplicity of second multiplier circuits (8-1, 9-1, 10-1, 11-1) which precede the multiplicity of second adder circuits (12-1, 13-1) and multiply the second error signal vector (Δa_1, Δb_1) by adjustable coefficients ($C_{aa}^{(2)}$, $C_{ba}^{(2)}$, $C_{bb}^{(2)}$, $C_{ab}^{(2)}$).

10. The circuit arrangement as claimed in claim 9, wherein the circuit arrangement also exhibits the following features:

- a further decision circuit (4-2) which maps the error-corrected second signal vector (a_2^*, b_2^*) into a value-discrete second signal vector (a_2'', b_2''); and
- a further subtracting circuit (6-2, 7-2) for forming a third error signal vector (Δa_2, Δb_2) which subtracts the second signal vector (a_2', b_2') and the value-discrete second signal vector (a_2'', b_2'') from one another,

the third error signal vector (Δa_2, Δb_2) being used for generating an error-corrected third signal vector (a_3^*, b_3^*) of a third signal vector (a_3', b_3') of a carrier frequency which is immediately adjacent to the carrier frequency of the second signal vector (a_2', b_2').

11. A circuit arrangement for compensating for disturbances in a signal generated by means of discrete multitone modulation (DMT), the signal generated by means of discrete multitone modulation exhibiting in the frequency domain a multiplicity of carrier frequencies which are used for transmitting data via a transmission channel, and each carrier frequency exhibiting a signal vector (a_1', b_1'; a_n', b_n'), comprising

- decision circuits which are in each case supplied with a reference signal vector (a_{1r}, b_{1r} to a_{mr}, b_{mr}) and which map the respective reference signal vector (a_{1r}, b_{1r} to a_{mr}, b_{mr}) into a respective value-discrete reference signal vector;
- subtracting circuits for forming a respective error signal vector which subtract the respective reference signal vector (a_{1r}, b_{1r} to a_{mr}, b_{mr}) and the respective value-discrete reference signal vector from one another;
- groups of first adder circuits (18-1, 19-1 to 18-m, 19-m), each group of first adder circuits (18-1, 19-1 to 18-m, 19-m) in each case being supplied with an error signal vector and the groups of first adder circuits (18-1, 19-1 to 18-m, 19-m) adding the respective error signal vector to at least one signal vector (a_n', b_n'; a_1', b_1') in order to generate a progressively error-corrected signal vector (a_n^*-1, b_n^*-1 to a_n*-m, b_n*-m); and
- groups of first multiplier circuits (14-1, 15-1, 16-1, 17-1 to 14-m, 15-m, 16-m, 17-m) which in each case precede a group of first adder circuits (18-1, 19-1 to 18-m, 19-m) and multiply the respective error signal vector by adjustable coefficients ($C_{aa}^{(1,n)}$, $C_{ba}^{(1,n)}$, $C_{bb}^{(1,n)}$, $C_{ab}^{(1,n)}$ to $C_{aa}^{(m,n)}$, $C_{ba}^{(m,n)}$, $C_{bb}^{(m,n)}$, $C_{ab}^{(m,n)}$).

12. The circuit arrangement as claimed in one of the preceding claims, wherein the adjustable coefficients can be adjusted by means of a correcting variable.

13. The circuit arrangement as claimed in claim 12, wherein a power of 2 is selected for the correcting variable.

14. A method for compensating for disturbances in a signal generated by means of discrete multitone modulation (DMT), the signal generated by means of

discrete multitone modulation exhibiting in the frequency domain a multiplicity of carrier frequencies which are used for transmitting data via a transmission channel, and each carrier frequency exhibiting a signal vector (a_1', b_1'; a_n', b_n'), comprising the following steps:

- multiplying at least one error signal vector by adjustable coefficients ($C_{aa}^{(n)}$, $C_{ba}^{(n)}$, $C_{bb}^{(n)}$, $C_{ab}^{(n)}$; $C_{aa}^{(1,n)}$, $C_{ba}^{(1,n)}$, $C_{bb}^{(1,n)}$, $C_{ab}^{(1,n)}$; $C_{aa}^{(1)}$, $C_{ba}^{(1)}$, $C_{bb}^{(1)}$, $C_{ab}^{(1)}$; $C_{aa}^{(n,1)}$, $C_{ba}^{(n,1)}$, $C_{bb}^{(n,1)}$, $C_{ab}^{(n,1)}$; and
- adding the at least one error signal vector multiplied by the adjustable coefficients to at least one signal vector (a_n', b_n'; a_1', b_1') in order to generate an error-corrected signal vector (a_n^*, b_n^*; a_n^*-1, b_n^*-1; a_1^*, b_1^*), wherein the at least one error signal vector is a signal vector (a_r, b_r; a_{1r}, b_{1r}; a_r-1, b_r-1) of a carrier frequency which is not used for transmitting data via the transmission channel.

15. The method as claimed in claim 14, wherein the first error signal vector is a signal vector (a_r, b_r) of a carrier frequency which, in the frequency domain, is adjacent to a carrier frequency which is used for transmitting data via the transmission channel.

16. The method as claimed in claim 14 or 15, wherein the first error signal vector is a signal vector (a_r, b_r) of a carrier frequency which, in the frequency domain, immediately precedes a carrier frequency which is used for transmitting data via the transmission channel.

17. The method as claimed in claim 14 or 15, wherein the method also exhibits the following steps:

- multiplying a respective further error signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}; a_r-2, b_r-2, a_r-3, b_r-3) by adjustable coefficients ($C_{aa}^{(2,n)}$, $C_{ba}^{(2,n)}$, $C_{bb}^{(2,n)}$, $C_{ab}^{(2,n)}$

to $C_{aa}^{(m,n)}$, $C_{ba}^{(m,n)}$, $C_{bb}^{(m,n)}$, $C_{ab}^{(m,n)}$; $C_{aa}^{(n,2)}$, $C_{ba}^{(n,2)}$, $C_{bb}^{(n,2)}$, $C_{ab}^{(n,2)}$); and

- adding the respective further error signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}; a_r-2, b_r-2, a_r-3, b_r-3) multiplied by the adjustable coefficients ($C_{aa}^{(2,n)}$, $C_{ba}^{(2,n)}$, $C_{bb}^{(2,n)}$, $C_{ab}^{(2,n)}$ to $C_{aa}^{(m,n)}$, $C_{ba}^{(m,n)}$, $C_{bb}^{(m,n)}$, $C_{ab}^{(m,n)}$; $C_{aa}^{(n,2)}$, $C_{ba}^{(n,2)}$, $C_{bb}^{(n,2)}$, $C_{ab}^{(n,2)}$) to the at least one signal vector (a_n', b_n') in order to generate a progressively error-corrected signal vector (a_n^*-2, b_n^*-2, to a_n^*-m, b_n^*-m).

18. The method as claimed in claim 17, wherein the respective further error signal vector is in each case a signal vector (a_{2r}, b_{2r} to a_{mr}, b_{mr}) of a carrier frequency which is not used for transmitting data via the transmission channel.

19. The method as claimed in claim 17 or 18, wherein the respective further error signal vector (a_r-2, b_r-2, a_r-3, b_r-3) is in each case a previous version of a particular error signal vector (a_r-1, b_r-1).

20. The method as claimed in claim 14, 15 or 16, wherein the method also exhibits the following steps:

- mapping the error-corrected first signal vector (a_1^*, b_1^*) into a value-discrete first signal vector (a_1'', b_1''); and

- subtracting the first signal vector (a_1', b_1') and the value-discrete first signal vector (a_1'', b_1'') from one another in order to form a second error signal vector (Δa_1, Δb_1), the second error signal vector (Δa_1, Δb_1) being used for generating an error-corrected second signal vector (a_2^*, b_2^*) of a second signal vector (a_2', b_2') of a carrier frequency which is immediately adjacent to the carrier frequency of the first signal vector (a_1', b_1').

21. The method as claimed in claim 20, wherein the method also exhibits the following steps:

- multiplying the second error signal vector (Δa_1, Δb_1) by adjustable coefficients ($C_{aa}^{(2)}$, $C_{ba}^{(2)}$, $C_{bb}^{(2)}$, $C_{ab}^{(2)}$); and
- adding the second error signal vector (Δa_1, Δb_1) multiplied by the adjustable coefficients ($C_{aa}^{(2)}$, $C_{ba}^{(2)}$, $C_{bb}^{(2)}$, $C_{ab}^{(2)}$) to the second signal vector (a_2', b_2') in order to generate the error-corrected second signal vector (a_2^*, b_2^*).

22. The method as claimed in claim 21, wherein the method also exhibits the following steps:

- mapping the error-corrected second signal vector (a_2^*, b_2^*) into a value-discrete second signal vector (a_2'', b_2''); and
- subtracting the second signal vector (a_2', b_2') and the value-discrete second signal vector (a_2'', b_2'') from one another in order to form a third error signal vector (Δa_2, Δb_2), the third error signal vector (Δa_2, Δb_2) being used for generating an error-corrected third signal vector (a_3^*, b_3^*) of a third signal vector (a_3', b_3') of a carrier frequency which is immediately adjacent to the carrier frequency of the second signal vector (a_2', b_2').

23. A method for compensating for disturbances in a signal generated by means of discrete multitone modulation (DMT), the signal generated by means of discrete multitone modulation exhibiting in the frequency domain a multiplicity of carrier frequencies which are used for transmitting data via a transmission channel, and each carrier frequency exhibiting a signal vector (a_1', b_1'; a_n', b_n'), comprising the following steps:

- mapping a respective reference signal vector (a_{1r}, b_{1r} to a_{mr}, b_{mr}) into a respective value-discrete reference signal vector;

- subtracting the respective reference signal vector (a_{1r}, b_{1r} to a_{mr}, b_{mr}) and the respective value-discrete reference signal vector from one another in order to form a respective error signal vector;

- multiplying the respective error signal vector by adjustable coefficients ($C_{aa}^{(1,n)}$, $C_{ba}^{(1,n)}$, $C_{bb}^{(1,n)}$, $C_{ab}^{(1,n)}$ to $C_{aa}^{(m,n)}$, $C_{ba}^{(m,n)}$, $C_{bb}^{(m,n)}$, $C_{ab}^{(m,n)}$); and

- adding the respective error signal vector multiplied by the adjustable coefficients ($C_{aa}^{(1,n)}$, $C_{ba}^{(1,n)}$, $C_{bb}^{(1,n)}$, $C_{ab}^{(1,n)}$ to $C_{aa}^{(m,n)}$, $C_{ba}^{(m,n)}$, $C_{bb}^{(m,n)}$, $C_{ab}^{(m,n)}$) to at least one signal vector (a_n', b_n'; a_1', b_1') in order to generate a progressively error-corrected signal vector (a_n^*-1, b_n^*-1 to a_n^*-m, b_n^*-m).

24. The method as claimed in one of claims 14 to 23, wherein the adjustable coefficients can be adjusted by means of a correcting variable.

25. The method as claimed in claim 24, wherein a power of 2 is selected for the correcting variable.